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Abstract

This paper explores rural household food consumption behaviour in China using a large household data set from Jilin Province. Data are classified into four main food groups—grain, vegetable products, animal products and other foods. A household food demand system, incorporating four household characteristics, is estimated using an LA-AIDS model, assuming a three-stage budgeting procedure. Expenditure elasticities for a range of food groups are estimated, with a particular focus on animal products. The inclusion of household characteristics did not have a big impact on the elasticity values in any of the three stages of the budgeting process. The total expenditure elasticity for grain (stage II) was 0.64, suggesting substantial future growth in household demand for fine grains such as rice and wheat, as per capita incomes continue to grow in rural areas. The highest conditional and total expenditure elasticity values were for the animal products (stage II) group, 1.22 and 0.76 respectively. Within this group the elasticities were highest for the meat sub-group at 1.14 and 0.87 respectively, suggesting an almost proportionate increase in demand as household incomes grow. Added demand pressures from animal production will likely keep grain policy high on the political agenda.

Introduction

In rural areas of China one of the main effects of the economic reforms has been to enhance the role of market forces in farm household production and consumption decisions. A fundamental change was the replacement of the commune system with the "household responsibility system" (HRS) whereby land and production responsibilities were placed under contract with individual farm households. To encourage private investment and the sustainable use of natural resources the land contract was expanded in the early 1980s from 1-3 years to 15-25 years (Davis *et al*. 2000); the Rural Land Contracting Law (2003) further extends the contract period to 30 years in most areas. The nature of the reforms led inevitably to a research agenda that tended to concentrate on the impact on farm household production and productivity. Designing an effective agricultural policy programme, however, depends not only on the "correctness" of the policy itself but also on understanding the response of the participants (farm households) in the policy implementing process. Moreover, as government investment targets and priorities are increasingly based on consumer demand forecasts, reliable estimates of, household demand for different commodities are important in informing policy design.

This paper explores rural household food consumption behaviour using a data set from Jilin Province in Northern China. It aims partially to fill a gap in the literature on the nature of household demand for livestock products in rural China. Jilin Province has a population of about 26 million and occupies a "middle" position in nationwide rural development indices. It is recognised as a predominantly agricultural province and is one of the main grain producing areas in China. The paper focuses in particular on the effects of household income and household characteristics on consumption behaviour. The work has two novel features. Firstly it

uses a high quality household data set for Jilin rural households and a rigorous and theoretically plausible modelling framework. Secondly it explores the impact of household characteristics such as family composition and education on household demand behaviour.

The paper begins with a brief review of previous household demand studies in China. It then moves to a consideration of data issues and outlines the classification of the data for analytical purposes into four main food groups—Grain, Vegetable Products, Animal Products and Other Foods. A household food demand system is estimated using a Linear Approximation of the AIDS (LA-AIDS) model—incorporating four household characteristics—based on the assumption of a three-stage budgeting procedure. Expenditure elasticities for a range of food groups are reported, with a particular focus on Animal Products.

Household demand studies in China

This section is a non-exhaustive overview of earlier studies of household demand in China. Apart from a study by Houthakker (1957)—which estimated income and price elasticities for food, clothing, housing, and miscellaneous items in
Beijing in 1927 and Shanghai in 1929—there were no statistical or econometric analyses of household demand and consumption in China before 1980. The main reasons were the poor availability and reliability of data and of course the existence of consumption rationing. The State Statistical Bureau (SSB) sample surveys, which started in 1955 and 1956 for rural and urban households respectively, were suspended in 1960 but commenced again after 1978.

The early studies in the reform era mainly used the Engel function and Linear Expenditure Systems (LES) to estimate expenditure and/or consumption patterns, mainly because of its simplicity and intuitiveness of economic interpretation. For example, Chow (1984), Van De Gaag (1984), and Li *et al.* (1985) used the Engel function and the LES to estimate consumption patterns in rural households in Hubei province and urban households in Beijing in 1981 and 1982. Chow (1987) estimated Engel functions for food, clothing, housing, and miscellaneous items using the 1981 expenditure data for rural households in 28 provinces of China. Using the pooled time-series and cross-sectional data from China's urban and rural household surveys for the year 1982 to 1985, Lewis and Andrews (1989) estimated the Chinese urban and rural household expenditure and income elasticities for a broad group of food, clothing, daily articles, other commodities, and non-commodities, and also for a sub-food groups of grain, pork, poultry and fish. None of these studies, however, took account explicitly of the household rationing system even though we would expect it to influence demand and consumption estimates. Gao, Wailes, and Cramer (1996), however, attempted to take account of rationing by using a differential Rotterdam mixed-demand system to estimate China's urban household food demand using aggregated data from 1987 to 1991. Their results showed that a mixed-demand model system performed better than those that ignored the rationing issue.

By the end of 1993 the grain rationing system had been abolished in most cities and towns. At about the same time the SSB household survey was reviewed and more than 400 items were added including rural household income and consumption indices. Both of these developments removed some of the constraints experienced by earlier household studies. This was followed by a growth in the number of household demand and consumption studies that gradually adopted more theoretically plausible

approaches, incorporating in particular the AIDS model, for example: Pinstrup-Andersen *et al.* (1990); Halbrendt *et al.* (1992, 1994); Fan *et al.* (1994); Li, and Samuel (1994); Fan *et al.* (1995); Wu *et al.* (1995); Wan (1996a, 1996b); Mittelhammer *et al.* (1996); and Gao *et al.* (1996a, 1996b).

Only a few studies have tried to take household characteristics into account. Halbrendt *et al.* (1994) used cross-section data for 1990 and the demographic translating method in a two-stage AIDS model to analyze rural household consumption behaviour in Guangdong province. They incorporated socio-demographic dummy variables for example geographical location, topography, households with or without rural leaders and/or government staff workers and education levels. They found that most of the socio-demographic dummy variables in the model were significant. For example, households with members who were rural leaders and/or government staff tended to spend more money on durable goods because their income levels were higher. Households with higher education levels spent a much higher proportion of their income on non-food items than they did on food items. Wu *et al.* (1995) examined the consumption patterns of urban households using aggregated 1990 household consumption data from 33 cities in China. By using a two-stage budgeting procedure, which incorporated an AIDS model in each stage, they estimated a six commodities (rice, pork, vegetables, fish, eggs and fruits) demand system. In this case, however, household characteristics were not taken into account. Gao *et al.* (1996) used an AIDS model on micro-level 1990 data from Jiangsu Province. They also used the demographic translating method to evaluate economic and demographic effects on rural household demand for nine food commodities and five non-food commodities groups. They found that households with family members

working in government, state industry, rural industrial enterprises or private business tended to have a higher standard of living than other households. They consumed more vegetables, poultry, fish, and fruit, and less grain. The educational level of household labour (usually meaning head of household) has no uniformly significant impacts on food consumption patterns. Thus whilst the number of household food demand studies in China has grown the literature remains relatively thin in relation to rural household demand for Animal Products. The paper aims partially to fill this gap using an extensive household database.

The data

We obtained data from the Provincial Statistical Bureau for a total of 1,520 rural households for each year from 1991 to 1995. The data were obtained from a rural sample survey covering 19 counties. Sampling is conducted in a multi-stage systematic way with a random start. The Provincial Statistical Bureau selects sample counties, then sample villages and finally sample households within the selected villages. The sampling method at each stage is controlled and is identical. Households maintain logbooks that separately record cash transactions—in value and volume terms—and own consumption/goods in kind exchanges. The Appendix table provides a statistical summary of the basic features of the sampled households and quantities of food consumed. In budget terms food was by far the largest item, accounting on average for almost 60 per cent of household expenditure in 1995. Clothing and housing costs were the next largest items accounting for a further 20 per cent of expenditure. Within the food category grain consumption was by far the largest item accounting for 45 per cent of the total food budget followed by meat and meat products at 14 per cent and vegetables at about 10 per cent (Jiang, 2001).

The data set is extremely large and in order to make the analysis feasible we assume that households adopt a three-stage budgeting procedure. In Stage I Food is treated as a separate budgeting category from other principal categories such as Clothing and Housing. In Stage II within the Food category households are assumed to budget separately for four categories: Grains; Vegetable Products; Animal Products; and Other Foods. In Stage III there is further separation of each category, for example the Animal Products category is sub-divided into three groups: Meat; Aquatic Products; and Eggs. In treating the data in this way we assume weak separability of preferences (Deaton and Muellbauer, 1980a). A utility function is weakly separable if and only if the goods can be partitioned into subsets in such a way that every marginal rate of substitution involving two goods from the same subset depends only on the goods in that subset. This means, for example, that the demand for a particular Food sub-group—say Animal Products—can be expressed as a function of the prices of the items in that sub-group and total expenditure on those items. Expenditure on and the prices of goods outside the Food group enter the demand functions for Food only through their effect on total expenditure on food. In this particular study, data availability allowed us to analyse Stage III budgeting only in the case of Animal Products.

We incorporate household characteristics into the estimation using the demographic translating method developed by Pollak and Wales (1978). In this method, translation parameters, d_i, are first defined as depending on demographic characteristics such that

$$d_i = D_i(h) \qquad (i = 1, \ldots, n)$$

where,

$h = (h_1, h_2, \ldots, h_j)$ is a vector of demographic characteristics.

The demographic variables can thus be added flexibly to the model. The translating method can be interpreted as allowing "necessary" parameters of the demand system to depend on household characteristics. Four such characteristics are selected for the estimation—based on the demographic information available in the data set: (a) number of people in the household; (b) proportion of household accounted for by children aged 0-11 years; (c) proportion of household accounted for by children aged 12-17 years: and (d) education level of the household, measured as the proportion of household labour educated to at least junior middle school level. Incorporation of these characteristics within the modelling framework is explained below.

The modelling approach

We use the Linear Approximation of the Almost Ideal Demand System, the so-called LA-AIDS model introduced by Deaton and Muellbauer (1980b). In the budget share form of the model we have:

$$w_i = \alpha_i + \beta_i \log\left(\frac{Y}{P^*}\right) + \sum_j \gamma_{ij} \log P_j \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where,

w_i is the household budget share on the *i*th commodity;

α_i, $\beta_{i,}$ γ_{ij} are parameters of the system; and

$$\gamma_{ij} = \frac{1}{2}(\gamma^*_{ij} + \gamma^*_{ji})$$

Y is total household income or expenditure;

p_j is the price of the *j*th commodity;

Y/P is "real expenditure"; and

P* is the Stone Price index given by,

$$\log P^* = \sum_i w_i \log P_i$$

where,

i is the *i*th commodity group,

w_i is the expenditure share of ith commodity group,

P_i is the aggregate price for the *i*th commodity group.

The name, Almost Ideal Demand System, stems from the properties associated with the system. Deaton and Muellbauer (1980b) list the following advantages: (a) it gives an arbitrary first-order approximation to any demand system; (b) it satisfies the axioms of choice exactly; (c) it aggregates perfectly over consumers; (d) it has a functional form which is consistent with previous household budget data; (e) it is simple to estimate in its linear approximate form (thus avoiding the substantial estimation problems of the non-linear pure AIDS model); and (f) it can be used to test for the restrictions of homogeneity and symmetry through linear restrictions on fixed parameters. In addition, the system is indirectly non-additive, allowing consumption of one good to affect the marginal utility of another good, whereas, the linear

expenditure system, for example, is directly additive, implying independent marginal utilities (Blanciforti and Green 1983).

As discussed above the incorporation of household characteristics follows the demographic translating method as follows:

$\alpha_i = \rho_{i0} + \sum^{d}_{s=1} \rho_{is} H_s$ ……..(2)

where,

H_s are the demographic variables of which there are d (s = 1,…,d).

ρ_{i0} and ρ_{is} are parameters to be estimated.

α_i is the intercept term in LA-AIDS model .

By substituting (2) into (1) we have an enhanced LA-AIDS model incorporating household characteristics:

$$w_i = \rho_{i0} + \sum^{d}_{s} \rho_{is} H_s + \beta_i \log \left(\frac{Y}{P^*}\right) + \sum_j \gamma_{ij} \log P_j$$

Now, ρ_{i0} is the new intercept term.

According to Alston *et al.* (1994), the uncompensated own-price, cross-price, and expenditure elasticities for this system are,

$$\varepsilon_{ii} = -1 + (\gamma_{ii}/ w_i) - \beta_i$$

$$\varepsilon_{ij} = (\gamma_{ij}/ w_i) - \beta_i (w_j/ w_i)$$

$$\eta_i = 1 + \beta_i / w_i$$

and the household variable elasticitity is,

$$\delta_{is} = H_{is}\rho_{is}/ w_i .$$

As household variables can influence the value and sign of the β_i, they can, therefore, influence the elasticity values.

We assume that all $w_i > 0$, thus we have a limited dependent variables model. A Tobit model is used for solving this problem, which takes the form,

$$w_{ih} = \rho_{i0} + \sum_s \rho_{is} H_s + \beta_i (\log Y_h - \log P_h) + \sum_j \gamma_{ij} \log P_{jh} + \mu_i$$

if, $w_{ih} > 0$

and, $w_{ih} = 0$

if, $w_{ih} <= 0$.

Now, μ_i is an independently distributed error term assumed to be normally distributed with zero mean and variance σ^2. Thus we use the Seemingly Unrelated Regression (SUR) method—developed by Zellner (1962)—in LIMDEP 7 for model estimation.

Results

Results are presented for Stage II and Stage III expenditure (income) elasticities. In Stage III we restricted our analysis to the Animal Products group (Stage II) due to the better availability of data for this group. But we also felt that this group (Meat, Eggs and Aquatic Products) is particularly interesting due to anticipated future growth in household demand, especially for meat.

We considered the theoretical restrictions of adding up, homogeneity and symmetry as they apply to demand systems. However, as the entire budget shares sum to unity, i.e. $\sum_i w_i = 1$, the adding up restriction is inherent in the data and therefore did not need to be tested. We estimated the models in Stages II and III with and without the homogeneity and symmetry restrictions imposed. Using the log-likelihood ratio test we found that in both Stages the restrictions on the parameters caused the ratios to decline significantly—compared to the models without restrictions—in the case of

Stage II but hardly at all in Stage III. We concluded that the theoretical assumptions of homogeneity and symmetry were rejected in Stage II but not rejected in Stage III (Animal Products group). Rejection of these assumptions in Stage II is not entirely surprising in the light of similar results from previous studies, see for example Deaton and Muellbauer (1980b) and Hossain and Jensen (2000). Moreover, when using the AIDS model on Spanish annual time-series food expenditure data, Molina (1994) found that the theoretical assumptions of homogeneity and symmetry were rejected, but that the model still provided plausible elasticities. Using the same approach we examined the impact of including household characteristics in the models. Chi-square tests suggested significant differences between the log-likelihood ratios at the 5per cent level for the models including the characteristics compared to those without. This suggested that the AIDS model incorporating household characteristics should produce superior results.

Table 1 presents the estimated Stage II and Stage III conditional and total expenditure (income) elasticities for the selected food groups. A conditional value in Stage II for example refers to the elasticity of that food group with respect to total expenditure on the four food groups in that stage, the latter amount having been determined at Stage I under the assumption of weak separability. The total (or real) value is the expenditure elasticity of a particular group with respect to total household expenditure on food and non-food items. If we assume no saving behaviour then the total expenditure elasticity is the same as the income elasticity. The total value, of course, is the more relevant measure when considering possible future changes in demand and also for policy analysis purposes.

In general we can say that the inclusion of household characteristics did not have a big impact on the elasticity values in either Stage I or Stage II. The most noticeable effects in Stage II were on the conditional and total elasticities for Grain and on the conditional values for Animal Products. The differences, however, were not significant. In Stage III differences were apparent only in the case of eggs but again the magnitudes were relatively small. The total expenditure elasticity for Grain in Stage II ranges from 0.64 to 0.67. This is substantially higher than estimates in previous studies of household demand in rural China. Wan (1996a) for example, using an Engel function on provincial rural household data, estimated an elasticity value of 0.4. Halbrendt *et al.* (1994), however, using and AIDS model estimated a value for rural Guangdong Province of 0.58. The total expenditure elasticity for vegetables is 0.45: which is substantially lower than the estimates in the Wan (1996a) and Halbrendt *et al.* (1994) studies of 1.04 and 0.91 respectively.

The highest Conditional and Total elasticity values were for the Animal Products group, 1.22 and 0.76 respectively. These are the only elasticity estimates that we are aware of in the literature for this particular (Stage II) food group. Within this group the elasticities were highest for the Meat sub-group at 1.14 and 0.87 respectively. This estimate is somewhat lower than the Halbrendt *et al.* (1994) estimate of 1.09 but consistent with the Fan *et al.* (1995) estimate of 0.9. It is also quite close to the estimate of 0.7 for meat in rural India by Abdulai *et al.* (1999). For a fuller review of elasticity estimates from previous studies see Jiang (2001). There seems likely to be four main reasons for the differences between the various elasticity estimates: (a) the most obvious is differences in coverage between urban, rural, region etc. and the inherent quality and suitability of the data sets; (b) the majority of previous studies excluded own-price effects which tended to lead to underestimates of the expenditure

(income) elasticity; (c) unlike some previous work this study explicitly takes account of the demand interdependencies of food items within a rigorous framework; and (d) studies before the mid 1980s tended to encounter the effects of central planning, particularly inadequate variation in price and income data. In this study, however, we have used a theoretically plausible AIDS model on high quality pooled household data and thus we feel confident that our results are less susceptible to the above sources of error.

We calculated the elasticity of household demand with respect to the four measured household characteristics. A number of the coefficients for the household characteristics were significant at the 95 per cent level. The absolute values of the elasticities, however, were relatively small. Perhaps of greatest interest was the negative impact of education level on Stage II household demand for Grains (elasticity -0.04), whereas it had a positive influence on demand for Animal Products (elasticity 0.06). The elasticity in Stage III for Meat was 0.04. These results are consistent with the occupational groups and roles of the more educated rural households in Jilin. Their members tend to be the cadres, rural teachers and village enterprise managers who frequently have important public relations roles to perform including the entertaining of guests and visitors.

Summary and conclusions

In this paper we have followed a three stage budgeting procedure, assuming weak separability of preferences, to allocate households' total expenditure within a complete consumption system. In Stage I we allocated total expenditure to food and non-food products. In Stage II food expenditure was allocated to four food groups: Grain; Vegetables; Animal Products; Other Foods. In Stage III we focused on the

allocation of expenditure on Animal Products to three sub-groups: Meat (Pork, Beef, Mutton, Chicken); Eggs; Aquatic Products. In this way a complete demand system for food was estimated—in a theoretically and econometrically plausible way—using the LA-AIDS modelling framework. We also incorporated four household characteristics in our specification. We used a high quality, highly disaggregated, household data set obtained from the Rural Jilin Provincial Statistical Bureau—a branch of the State Statistical Bureau. This is the first detailed household food demand study conducted in rural Jilin province. Of course the results apply only to this particular rural region. However, the "middle" position of Jilin in relation to nationwide rural development indices means that, arguably, the results provide a closer approximation to the national rural position than previous studies on, for example, Guangdong and Jiangshu Provinces or Beijing City.

The relatively high positive expenditure elasticity for Grain confirms that it was a normal good during the period studied. Substantial growth in household demand, therefore, can be anticipated, particularly for fine grains such as rice and wheat, as per capita incomes continue to grow in rural areas. In the circumstances it is likely that the internal demand pressures will continue to keep the Grain "self-sufficiency" goal high on the list of policy priorities.

At the same time, rural households have been shifting their consumption from coarse grains in particular towards Animal Products. We found that this group had the highest expenditure (income) elasticities of all the groups studied. Our results suggest that we can anticipate an almost proportionate increase in demand for Meat as household incomes grow. Of course this will result in considerable growth in indirect demand for Grain as a key input in animal production. Thus the composition of

domestic demand for Grain will change but the added pressures from animal production will also serve to keep grain policy high on the political agenda.

Although we found that household characteristics did exert some influence on demand the overall impact of the variables we were able to use was relatively low. Further work might incorporate different variables such as household location, gender and occupation of household members. Unfortunately these variables were not available to us in the secondary data set. And of course it would be informative to analyse demand within the Meat category in more detail if sufficiently disaggregated data were available.

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Table 1 Conditional and Total Household Expenditure Elasticities

		Food Groups	Conditional Expenditure Elasticities	Total Expenditure Elasticities
Stage II	Without household characteristics	Grain	1.05	0.67
		Vegetables	0.71	0.45
		Animal Products	1.20	0.76
		Other Foods	0.83	0.52
	With household characteristics	Grain	1.03	0.64
		Vegetables	0.70	0.44
		Animal Products	1.22	0.76
		Other Foods	0.84	0.52
Stage III	Without household characteristics	Meat	1.15	0.88
		Eggs	0.81	0.61
		Aquatic Products	0.65	0.50
	With household characteristics	Meat	1.14	0.87
		Eggs	0.85	0.65
		Aquatic Products	0.65	0.50

Appendix

Basic indicators of rural households in Jilin, 1991-1995

Item	Unit	1991	1992	1993	1994	1995
General information						
Permanent residents in the households surveyed	person	7090	6926	6742	6612	6436
Average permanent residents per household	person	4.43	4.33	4.21	4.13	4.02
Average full-time and part-time labourers per households	person	2.67	2.61	2.67	2.74	2.64
Numbers of labourers illiterate and semi-illiterate per 100 labourers	person	7.84	7.06	6.97	6.65	5.02
Number of labourers at primary school level per 100 labourers	person	40.07	38.77	39.5	37.77	37.06
Number of labourers at junior middle school level per 100 labourers	person	42.65	44.68	44.02	46.1	49.21
Number of labourers at senior middle school level per 100 labourers	person	8.45	8.47	8.6	8.52	7.6
Number of labourers at polytechnic second school level per 100 labourers	person	0.83	0.91	0.75	0.8	0.73
Number of labourers at college level per 100 labourers	person	0.16	0.12	0.16	0.16	0.38
Household annual per capita net income	yuan	748.33	807.41	891.61	1271.6	1609.6
Household annual per capita living expenditures	yuan	648.41	643.13	670.02	853.73	1494.6
Per capita food consumption						
Coarse Grain	kg	304.04	304.11	324.16	331.54	348.6
Rice	kg	133.98	138.32	134.95	133	143.46
Vegetables	kg	151.08	148.6	142.91	168.67	159.83
Edible vegetable oil	kg	4.34	4.45	4.08	4.97	5.48
Edible animal fat	kg	1.74	1.73	1.43	1.19	2.09
Pork	kg	9.3	8.56	8.7	7.49	10.61
Beef and mutton	kg	0.37	0.45	0.35	0.31	0.49
Poultry	kg	0.61	0.88	0.88	1.31	1.97
Eggs and its products	kg	4.81	3.45	4.05	5.14	6.9
Fish and shrimp	kg	1.92	1.72	1.98	2.27	3.54
Sugar	kg	0.57	0.7	0.45	0.48	0.63
Fruit	kg	5.06	6.11	8.66	9.49	9.23
Cake	kg	1.14	1.05	1.22	1.35	1.92
Tobacco	box	16.65	15.5	15.05	15.55	21.9
Liquor	kg	7.01	6.61	7.65	8.21	8.08

Source: *Statistical Yearbook of Jilin*, (1996).